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OFFICE OF SECRETARY

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November 14, 1994

William F. Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W.
Washington, D.C. 20554

DOCKET FILE COPY ORIGINAL

Re: PR Docket No. 93-61

Dear Mr. Caton:

On Monday and Tuesday October 24 and 25, 1994, Larsh Johnson of CellNet Data Systems, Inc. and I met with Ruth Milkman, Senior Legal Advisor to Chairman Hundt, James Coltharp, Special Advisor to Commissioner Barrett, David Siddall, Legal Advisor to Commissioner Ness, and Messers. Ronald Netro, Martin Leibman and Thomas Dombrowsky of the Private Radio Bureau staff, to discuss the views of CellNet in the above referenced proceeding, all of which are stated in CellNet's several pleadings in this matter. The attached materials were provided as background on the company and a summary of the company's position in this matter.

Two copies of the letter are being submitted to the Secretary pursuant to Section 1.1206 of the Commission's Rules. Copies are also being provided to the offices of Commissioner Quello and Commissioner Chong and to the office of the Chief Engineer, with whom meetings could not be arranged.

Please call me if there are any questions about this filing.

Sincerely,
Wilkinson, Barker, Knauer & Quinn

By: Lawrence J. Movshin
Partner

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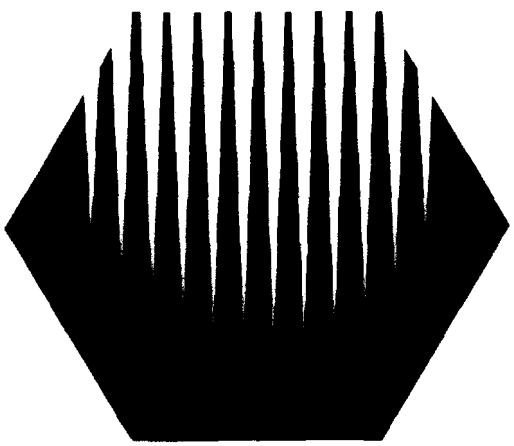


CELLNET

DATA SYSTEMS

CellNet Overview

10 years in industry

- 150,000 electric metering micro-computers to 100 U.S. utilities

6 years in development of wireless network

- 4 years of field testing
- 2 years commercial deployment
  - 7,000 meters, 400 distribution automation sites, 4 utilities
- Backlog: 425,000 fixed network meters

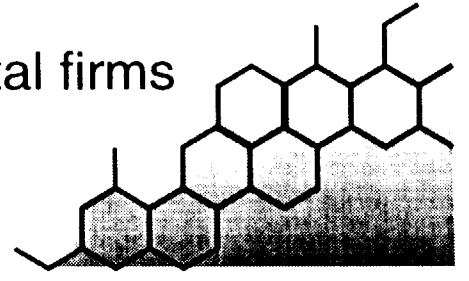
Experienced management team

- Paul Cook, Chairman — Founded Raychem, a $1.2 billion company
- John M. Seidl, CEO - Former President of Enron
- Senior executives with high-technology and utility experience

Privately held

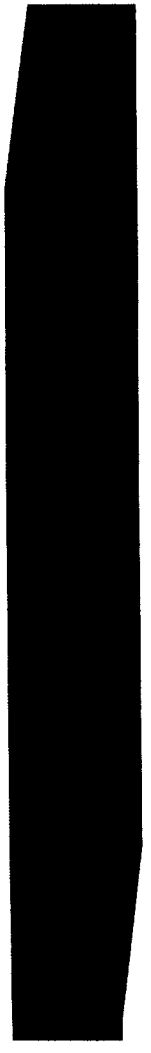
- $50 million invested in development
- Backed by AT&T, major banks, and top venture capital firms

Headquarters 15 miles south of San Francisco



Wireless Data Automation Markets

Dollars per Month, including hardware



$20.00

$10.00

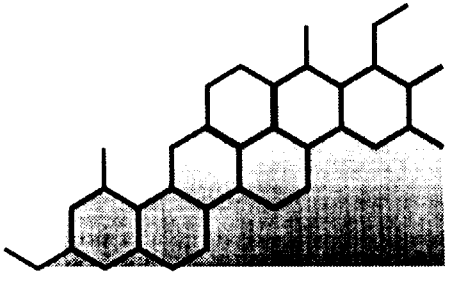
$5.00

$2.00

$1.25

$0.75

Distribution Automation
Short Burst E-mail
Credit Card Verification
Home Security/Personal Safety Devices
Vending Machine Monitoring
Pager Return
Traffic Light Control
Electric Car Charging/Billing
Vehicle Tracking
Utility Load Research
Copier/Other Machine Messaging
Real-Time Pricing
Home Fire Alarm
Time-of-Use Telemetry
Electric Meter Telemetry
Gas Meter Telemetry
Water Meter Telemetry

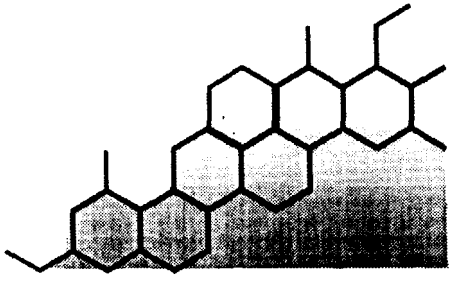


Design Requirements

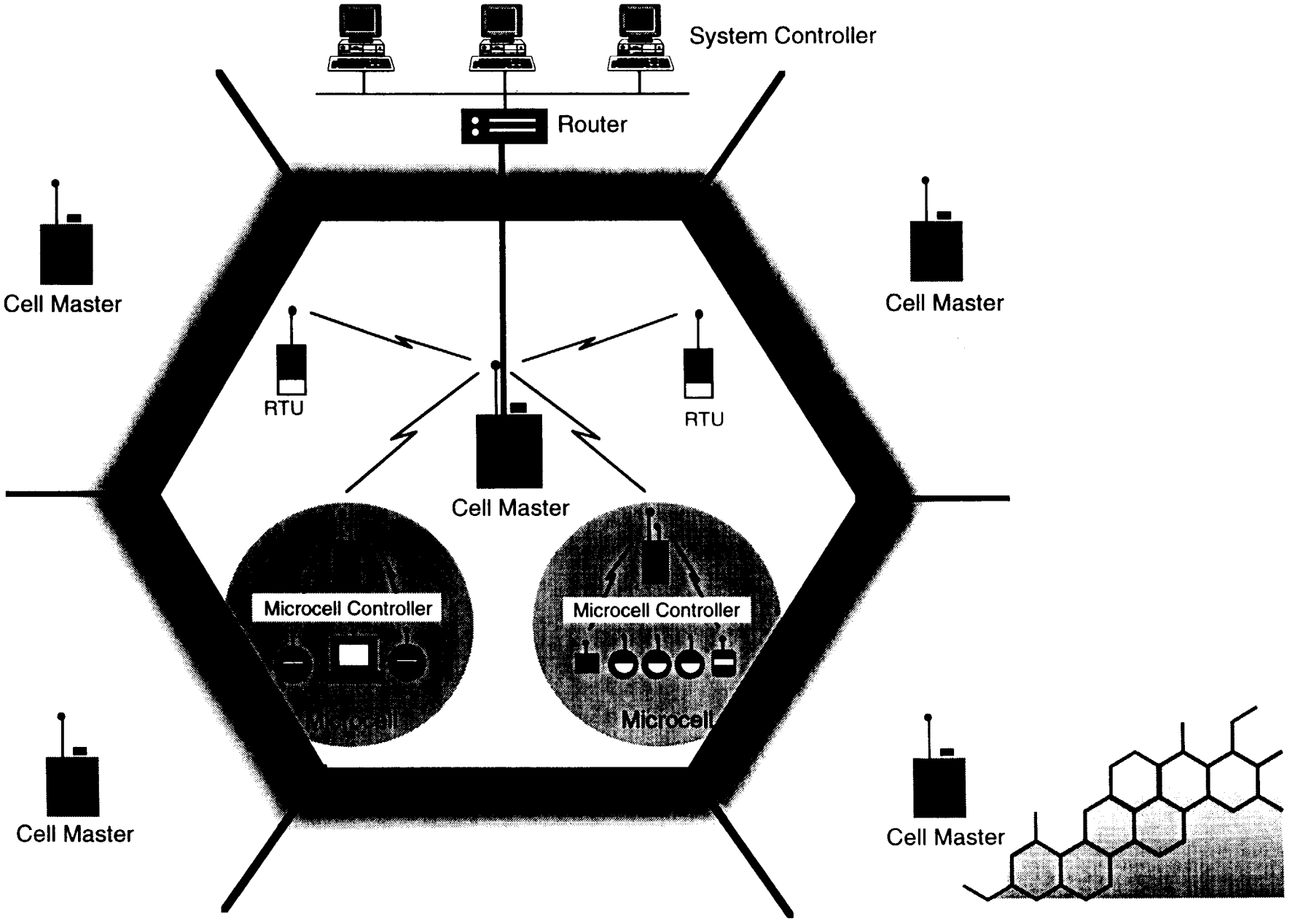
Utility Needs

- Low Cost & High Volume
  - Automated Metering
  - Customer Communications
  - Variable Rates
- Rapid Response & Predictability
  - Switch Control
  - Capacitor Control
  - Outage Notification

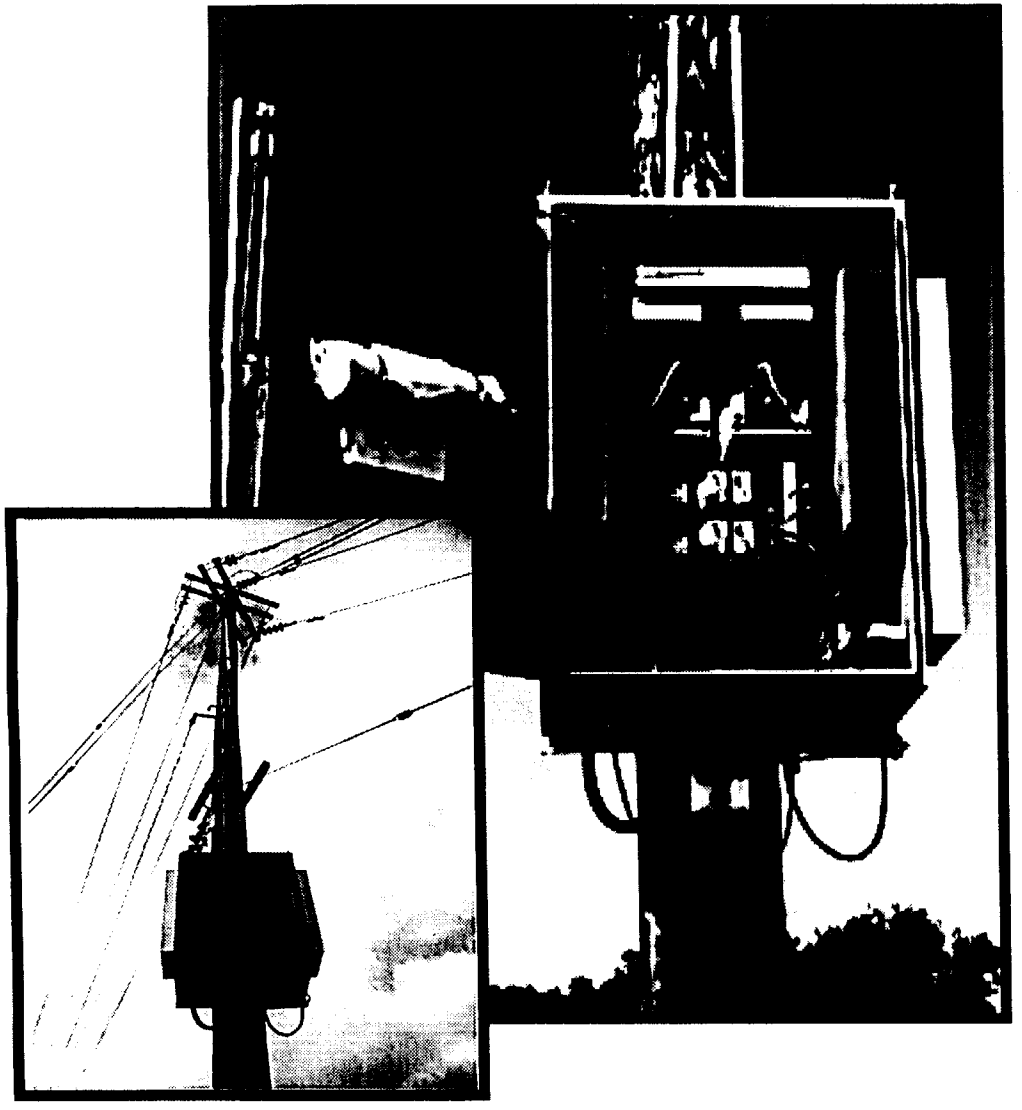
- **Result: Process control model with centrally-managed communications**



CellNet System Architecture

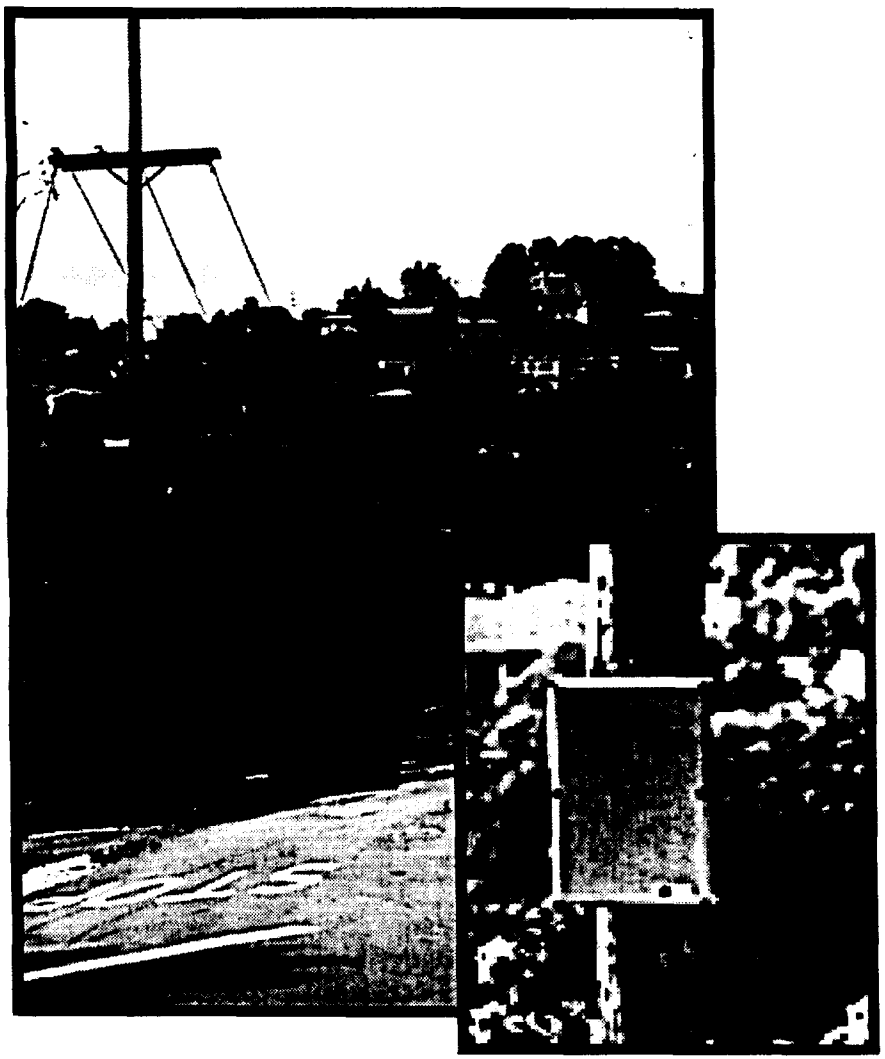


9QPR Cell Master



- 50-200 square mile coverage
- Fully redundant hardware
- Automatic switchover
- Two communication links to System Controller
- Active thermal compensation for outdoor operation
- Dynamic control of remote radio transmit power level

Microcell Controller

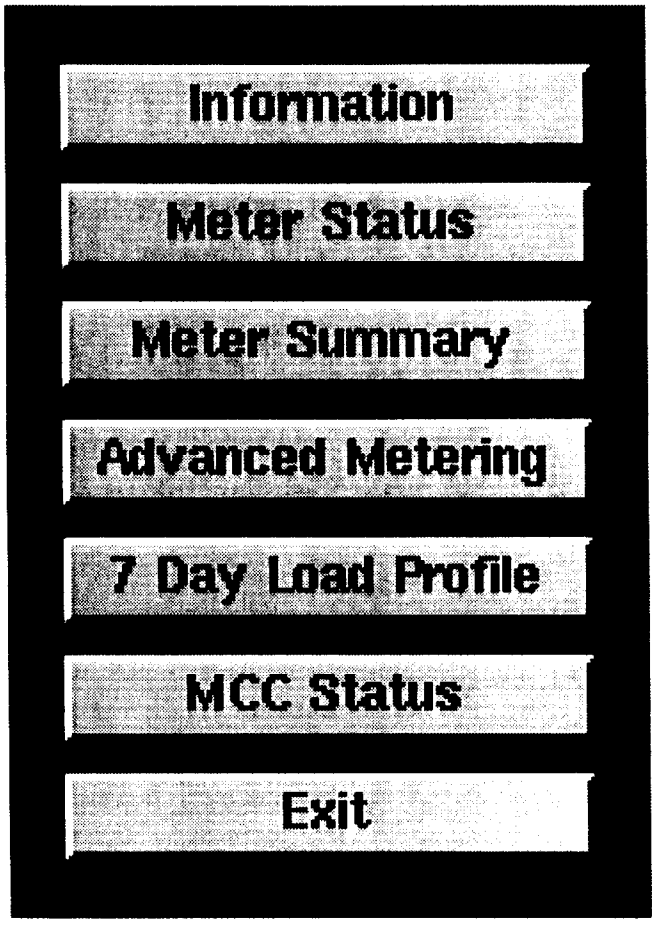


- **Performs data concentration, data processing, and network routing**
- **Voltage monitoring and power outage detection**
- **9QPR WAN radio**
- **Microcell radio**
- **20 MHz microprocessor with 8MB memory**
- **Backup battery**
- **Expansion capabilities**

Electric Meter

- Retrofits under glass of electro-mechanical meters
- Supports kWh, time-of-use, load profile, and real-time pricing
- Available for industrial, commercial, and residential meters
- Outage and theft detection

Metering Applications

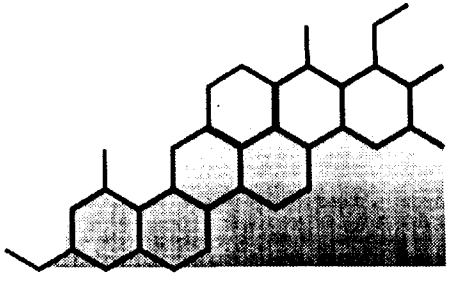


Basic AMR

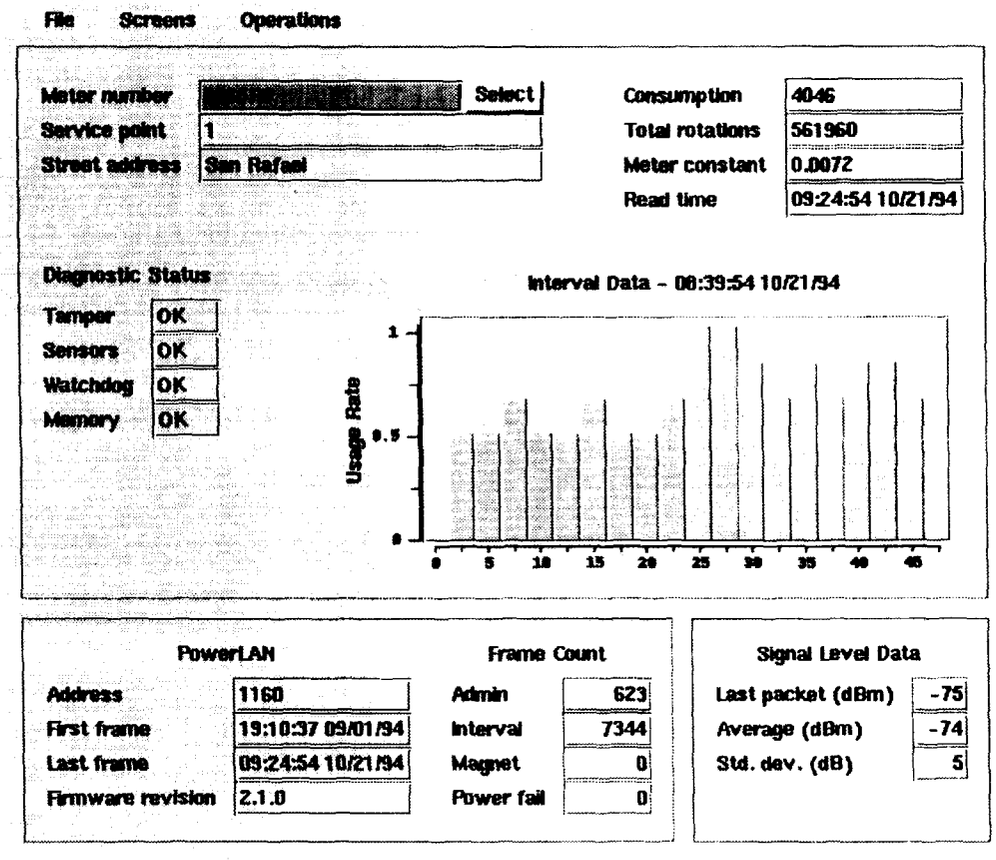
File Screens Operations

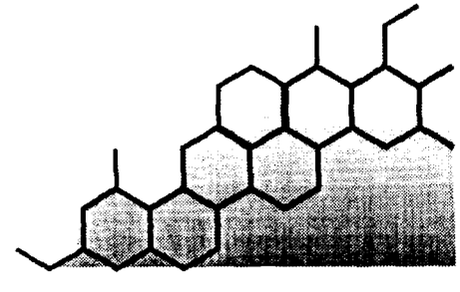
Meter group [redacted] Select

Meter number	Consumption	Time	Date	Avg Sig	LAN addr	Status
0220R4	3106	09:17:21	10/21/94	-81 dBm	964	OK
0238R4	1	09:14:28	10/21/94	-82 dBm	549	OK
0864R8	1496	09:23:11	10/21/94	-78 dBm	1542	OK
0864R9	1334	09:23:23	10/21/94	-69 dBm	1353	OK
0865R0	4046	09:24:54	10/21/94	-74 dBm	1160	OK
0865R1	1297	09:25:27	10/21/94	-73 dBm	1834	OK
0870R4	1602	09:25:45	10/21/94	-54 dBm	1406	OK
0870R5	1694	09:25:23	10/21/94	-60 dBm	1338	OK
0870R6	1888	09:26:44	10/21/94	-38 dBm	1635	OK
0870R7	1291	09:28:31	10/21/94	-56 dBm	1427	OK
0873R2	2096	09:29:28	10/21/94	-67 dBm	1473	OK
0874R0	1113	10:48:04	10/06/94	-60 dBm	1913	OK
0889R6	837	09:31:09	10/21/94	-86 dBm	1743	OK
0889R7	649	09:25:51	10/21/94	-86 dBm	1591	OK
0889R9	1155	09:29:26	10/21/94	-86 dBm	1823	OK

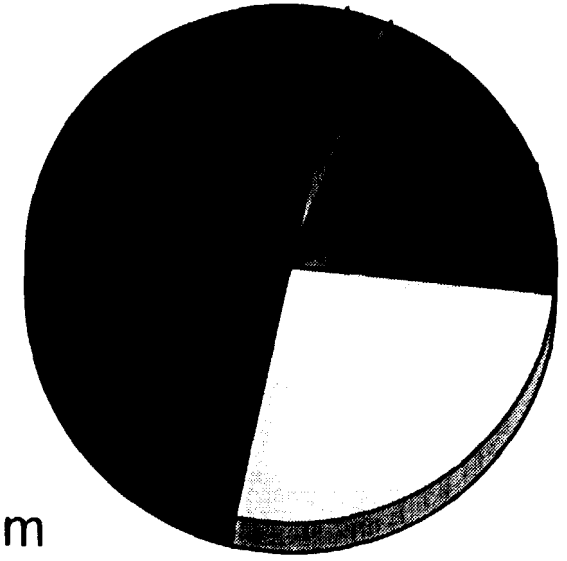


Meter Status





CellNet System Usage: Example



- Load Research (3.7%)
- Meter Reads (2.4%)
- Critical System Points (12.5%)
- Alarm Points (8.3%)
- SCADA Points (26.7%)
- Remaining Time (46.4%)

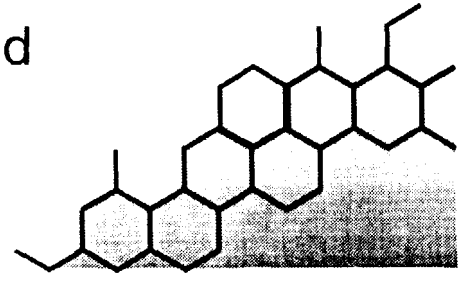
Total: 100%

Scenario

- 500,000 customers
- 20 cell CellNet system

Requirement

- Read 500,000 electric meters daily
- Read 10,000 customers' load profile every 15 minutes
- Read 350,000 gas meters daily
- Activate and verify 200,000 load controllers twice daily
- Monitor status of 1,000 critical system points every second
- Monitor 20,000 alarm points every 30 seconds
- Read data from 800 SCADA RTUs every 10 seconds



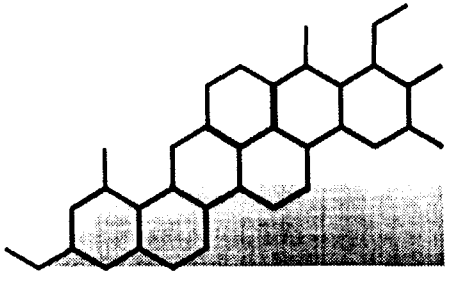
Utility is Positioned for the Future

Demand side management

- Time-of-use rates
- Real-time pricing
- Load control verification
- Home energy management
- Load curtailment
- Electric vehicles

Distribution SCADA

- Outage detection & resectionalizing
- Fault detection
- Switch automation
- Real time volt/VAR control
- Feeder monitoring



Summary: Utility-CellNet Goals

Use capital efficiently

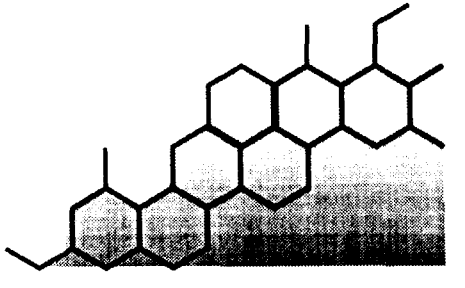
Reduce O&M expenses

Mitigate risks of automating

- financial
- technical
- operational

Enhance revenue opportunities

Position utility for the future



CellNet Position - PR Docket No. 93-61

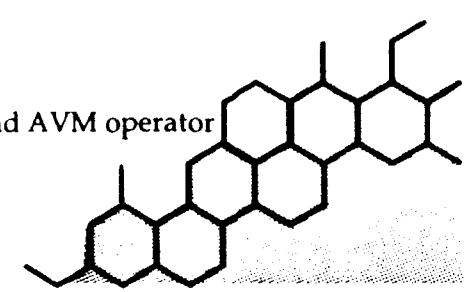
- **Support Part 15/AVM Test Plan to Establish Interference Potential**
  - Shared use is possible but only if the Commission adopts Rules based on joint testing by the AVM and Part 15 industries.

- **Adopt a Band Plan Consistent with Shared Use by Part 15 and AVM/LMS**
  - High Power Narrowband Forward Links Restricted to 902 - 905 MHz and 925 - 928 MHz.
  - Restrict Wideband Transmissions to Low Power Reverse Links.
  - Allocate Upper and Lower Wideband Channels outside of 910-920 MHz.

- **Adopt Technical Standards for AVM/LMS Systems**
  - Wideband and Narrowband Transmission Masks.
  - Receiver Processing Gain Standards*.

- **Presume Non-Interference to AVM Systems by Part 15 Equipment**
  - If necessary Set Interference Criteria Based on Test Results.

* If Part 15 is presumed not to interfere this requirement may be eliminated and be driven by system and AVM operator requirements.



CELLNET
DATA SYSTEMS

NEWS RELEASE

For Immediate Release

For further information, contact:
Rachel Silber, CellNet Data Systems, (415) 508-6040
Lisa La Magna, Abernathy MacGregor Scanlon, (212) 371-5999

CELLNET DATA SYSTEMS CONTRACTS TO PROVIDE LARGEST WIRELESS AUTOMATION SYSTEM IN U.S.

Kansas City Power & Light To Use Wireless Automation Network to Read Meters and Control Power

San Carlos, California, September 1, 1994 — CellNet Data Systems, Inc. today announced that it has signed a long-term communications services contract to provide Kansas City Power & Light (NYSE: KLT) with a real-time wireless network that will automate such activities as meter reading and power distribution and provide data for load management and time-of-use pricing. By the end of 1996, KCPL's 400,000 urban customers will be on-line with the CellNet system in the largest wireless data automation system in the United States.

"KCPL recognizes the challenges facing the electric utility industry," said Cree Edwards, Vice President of Business Development at CellNet. "As competition continues to increase, more utilities will follow KCPL's lead in looking for innovative ways to increase efficiency. With CellNet's system, a utility can more effectively control the cost and complexity of its distribution system and operations."

This marks the first time that a power utility will have real-time access to power usage data throughout its entire distribution network — raising the standard of customer service for the industry by increasing service options for the customer. The CellNet system provides real-time

125 SHOREWAY ROAD
SAN CARLOS, CA 94070
TEL 415.508.6000
FAX 415.592.6858

more

access to power electricity usage levels at all of KCPL's customers. When fully deployed, KCPL can enhance electric service, including power quality and reliability.

"KCPL is committed to providing outstanding service to each and every one of our customers. CellNet's technology establishes a platform upon which to build even better electrical service and provide greater value to KCPL customers," said Drue Jennings, KCPL's President.

"Customer service is our most important task," said Charles R. Cole, Vice President of Customer Services at Kansas City Power & Light. "For years we evaluated automation tools. CellNet provides the only automation package that dramatically improves operating efficiency and protects our ratepayers and shareholders from technology risk. It's one part of our strategic platform for growth and customer service."

CellNet's technology emerges in the electric utility marketplace at a time when utilities are reaching for new ways to provide increased levels of customer service. CellNet's advanced wireless information technology system provides an edge in operating efficiency. Three other electric utilities have also contracted to make more limited initial use of CellNet's system — Georgia Power, Northern States Power, and Pacific Gas & Electric.

Founded in 1984, CellNet Data Systems, Inc. is a wireless network operator specializing in the collection, processing, and delivery of data. Building on advances in cellular technology, CellNet has developed a low-cost wireless data communications solution that reduces the cost and complexity of accessing and managing data from remote locations — thereby increasing efficiency, profitability, and competitiveness. CellNet's network has applications in the electric, gas, and water utility industries; in the vending machine industry, to monitor inventory levels and cash receipts; in the home security business, to detect security breaches without relying on wires; and in paging return, vehicle tracing, traffic light control, and other uses.

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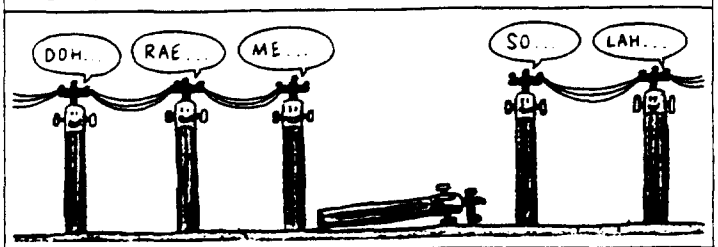
Developments to Watch

EDITED BY RUTH COXETER

'SMART' POWER METERS MAY HELP CONSERVE PRECIOUS JUICE



To feed America's growing energy appetite during peak hours, utilities may spend billions on new power plants over the next five years. They would like to limit plant construction by enticing homeowners to shift consumption to off-peak hours. But creating incentives, such as variable pricing, requires much closer monitoring of usage patterns.

That's why power companies are rushing to automate everything—from meter reading to monitoring outages. To help, Cellnet Data Systems Inc. in San Carlos, Calif., has created an "intelligent" network system linking thousands of meters and power lines to a power company's computer network via low-cost radio transmitters. Data flow between the transmitters and a central computer that tracks consumption and signals power-line outages. Cellnet is working with Georgia Power Co. and Northern States Power Co. in Minneapolis. It just signed a contract to bring Kansas City Power & Light Co.'s 420,000 customers on-line by the end of 1996.

WILL GIANT CRYSTALS TOUGHEN UP GIANT TURBINES?

Ordinary metal alloys look uniform, but under the microscope they're a multicrystalline crazy quilt. That's because as molten alloys cool, crystals branch out from many points like frost on a window. At high temperatures, alloys are weakest where different crystals abut. To make stronger aircraft-engine parts, scientists at United Technologies Corp.'s Pratt & Whitney Co. in the late 1970s controlled the cooling of molten-nickel alloys so each part was a huge crystal grown from one "seed." That's now the norm for jet-engine parts.

Howmet Corp. in Greenwich, Conn., a unit of France's Pechiney that makes single-crystal parts for jet engines, hopes to use the technique for the much bigger blades and vanes used in power-generation turbines. Single-crystal parts would allow turbines to run hotter, improving efficiency. Blades in a big power turbine are a foot or longer, compared with just a few inches for a jet engine. That much molten metal tends to deform ceramic molds and cool unevenly, so multiple crystals form. Now, Howmet is developing rigid, more durable molds and better furnace controls that guide the crystal to grow from a single seed. It has made parts as long as two feet but not yet in large quantities.

HELPING EPILEPTIC BRAINS FIND THEIR WAY BACK TO CHAOS

When biological systems go haywire, order, not chaos, can be suspect. During chemically induced seizures in rats, for example, neurons fire erratically but in unison—a phenomenon called chanting. Now, scientists at George Washington University and Georgia Institute of Technology suggest that it's possible to nip human epileptic seizures in the bud by restoring chaotic brain activity before abnormal harmonies take hold.

Suppressing chaotic reactions is routine work for mechanical engineers. And in medicine, electrical pulses are used to smooth out rapid, irregular muscle contractions that cause heart attacks. Deliberately inducing chaos is more controversial, researchers say. Further animal tests are needed before anyone tangles with the human brain. But if all goes well, doctors treating severe epilepsy may no longer need to prescribe heavy drugs, or slice away damaged brain tissue. Instead, they could implant tiny electrodes around the site to detect the rhythmic onset of neuronal "chanting," then nudge the cells back to a more natural state of chaos.

PHOTOCHEMISTRY GETS DOWN TO 'BASICS'

Computer chips and dental work have something in common: Both rely on photochemical reactions. After spreading dental putty, dentists use a blue light to trigger a rapid hardening. Similar chemistry is key to printing circuits on silicon—only the light is ultraviolet. In one common type of photochemistry, light sets off a reaction between a light-sensitive molecule and a polymer, forming cross-linkages in the polymer. The light-sensitive molecule is either an acid or a "free radical," a substance with an extra electron.

Charles Kutal, the University of Georgia's chemistry department chair, is developing a whole new type of photochemistry. He's making light-sensitive molecules that are bases, the opposite of acids. He says acids can linger, causing corrosion. And reactions involving free radicals are inhibited by oxygen. Bases have neither of those problems. Kutal's research team has developed "basic" epoxy compounds that could be used for dental work as well as for chip circuitry, coatings, and inks—and even sutures for eye surgery. He says several companies have expressed interest.

A BUG ALERT FOR BREAKFAST CEREAL

Extra raisins may lure breakfast-cereal buyers. But one additive doesn't: bug parts. "It's a matter of sanitation," says University of Texas at Austin chemist Barrie Kitto. "The more insects you find, the more likely there is contamination from other pests, like rodents."

Current standards permit 75 insect fragments per 50-gram grain sample. But conventional visual inspection misses insect eggs and larvae inside grain kernels. So Kitto developed a simple $5 test for myosin, a protein present at all stages of an insect's life. A specially treated plastic stick is dipped in a blend of grain and saline solution. The more myosin present, the greener the stick turns. Just two micrograms of myosin in a kilo of wheat can be detected, says Kitto. Major companies such as ConAgra, Pillsbury, and Cargill are evaluating the test.

M E COHEN

THE KANSAS CITY STAR.

September 2, 1994 JOHNSON COUNTY EDITION

Area meter reading to lose human touch

By MARTIN ROSENBERG
Staff Writer

Say goodbye to your Kansas City Power & Light Co. electric meter reader.

KCP&L announced Thursday that it would soon attach cellular radio transmitters to your electric meter so it can read the meter, calculate your electric use and instantly spot outages. Fifty-three meter readers will be deployed to other jobs.

KCP&L said the cellular radios will be put on all 420,000 of its meters by the end of 1996. It said it will become the first utility in the country to deploy wireless communications across its entire power system.

The meter-reading system will be built and maintained by CellNet Data Systems Inc., of San Carlos, Calif., which will sell the meter data to KCP&L each month. Both companies declined to disclose financial details.

KCP&L says the cost of the new system will about equal the cost of fielding meter readers, and will

See **KCP&L, A-20,** Col. 1

Continued from A-1

not result in any rate increase.

By hitching up to the information highway, KCP&L said, it will eventually be able to field an array of new services.

For instance, KCP&L spokesman David Martin said, it could offer variable rates that would allow a family to save on its electric bill by drying clothes and running the dishwasher at night when electricity demand and rates are low.

Eventually, KCP&L said, it may be able to tell customers how much electricity is used to run each appliance.

And if a customer volunteers to help curb electricity demand, KCP&L would be able to broadcast a signal that briefly turns off an appliance such as an air conditioner. The homeowner would save on his electric bill, while his home should not be noticeably warmer.

KCP&L and CellNet are reviewing whether to offer the same communications capability to water and gas companies, said Turner White, KCP&L senior vice president. Municipalities could use the network to monitor smoke alarms, even when a house is empty.

KCP&L's plan is more evidence that the information highway is barreling to our homes. Some utilities are exploring whether to read meters using fiber-optic phone lines that soon will carry interactive video to the home. But KCP&L decided to go with a technology available today at a lower cost, Martin said.

For a decade, KCP&L has considered a variety of technologies to automate meter reading.

CellNet, founded in 1994, several weeks ago raised $31 million by selling stock to private investors. Among the investors in the company is AT&T Ventures, a subsidiary of American Telephone & Telegraph Co.

Cree Edwards, vice president of business development at CellNet, said CellNet intends to hire crews in the Kansas City area to install 4-inch, moon-shaped radio transmitters in 420,000 meters within the next 28 months and build a citywide network to gather the data. The transmitters will sit inside the glass meter container.

The transmitters will be attached to 5,000 meters this year, 70,000 next year and the balance by the end of 1996.

Human meter readers come by only once a month, but their electronic replacements are much more active. Once a day, the transmitter will record the position of the meter's dials and transmit the information in a part of the radio spectrum reserved for utilities.

CellNet says the transmitters pose no health threat because they are low-powered devices. The

KCP&L to leave meter reading to cellular radio transmitters

company says they use less power than a cellular phone.

The device can transmit a reading every 2.5 minutes. Frequent transmissions would be needed if KCP&L decides to offer variable rates.

A special computer called a "controller" will monitor about 500 meters in a square-mile area. A "cell master" will collect the data from 50,000 meters. A "system controller" will compile the data for the entire city.

The new system will allow the utility to be more flexible in timing bills. For instance, a senior citizen may want bills to become due after he or she receives a Social Security payment. Currently, the timing of the bills depends on when a meter reader passes the home.

In addition, KCP&L said that the new system will allow quicker control of its 15,000-mile distribution network extending from neighborhood sub-stations to businesses and residences. When power is interrupted, the transmitter will emit one last gasp signalling that an outage has occurred.

"We will know how many crews to be assigning, and what to look for," Martin said.

Rachel Silber, a spokeswoman for CellNet, said that the same backbone network CellNet will build in Kansas City could be used to pick up signals from smoke detectors and security alarms.

Devices attached to the alarms or meters would emit radio signals that would be picked up by CellNet computers in the neighborhoods, she said.

HOW IT WORKS

1. Your electric meter will be read by a cellular phone-like device placed in the glass bell of the meter. The device can send a signal every 2.5 minutes.

2. The signal will be gathered by a "controller," which will cover a square-mile and collect data from about 500 meters. It is capable of two-way communications with your meter.

3. The controller will send the data to another computer, which will collect the information from 50,000 meters.

4. That computer, along with others covering the metropolitan area, will send the data to a master computer at KCP&L headquarters. The master computer will allow KCP&L to more efficiently manage peak usage. It will also help pinpoint outages and more rapidly restore power.

BEVERLY BYNUM/ The Star

CELLNET
DATA SYSTEMS

NEWS RELEASE

FOR IMMEDIATE RELEASE

For Further Information Contact:
Rachel Silber
(415) 508-6040

CellNet's Wireless Data Network Chosen by Georgia Power Company Will Automate 1996 Atlanta Olympics

San Carlos, CA (June 17, 1994)—CellNet Data Systems, Inc. announced that its wireless data transmission network has passed rigorous testing and has been accepted by Georgia Power Co. to provide utility distribution automation and wireless data communications in Metropolitan Atlanta, the site of the 1996 Summer Olympics.

With CellNet's technology, Georgia Power system operators can monitor power usage in Atlanta on a real-time basis and closely track the power needs of special customers, such as the organizers of the 1996 Olympic Games. CellNet's system will also detect faults in power lines and remotely reroute power around troubled areas—all from Georgia Power's control center. This creates a much faster and more cost efficient method of restoring service. Georgia Power will also be using the system to ensure that their customers are receiving high quality power. The system will help Georgia Power maintain voltage levels, which is increasingly important as more and more customers have electronically sensitive equipment such as personal computers in their homes.

"Georgia Power is a great partner and a technological leader in the electric utility industry," said Cree Edwards, Vice President of Business Development at CellNet. "Our system will enhance Georgia Power's capability to improve power quality and rapidly respond to customer concerns—an issue of growing importance as competition increases in the marketplace."

Frank Lambert, Georgia Power's Distribution Manager said, "As Georgia prepares to host the 2,000,000 athletes and fans that will converge on the greater Atlanta area, Georgia Power plans to utilize the CellNet system to handle the added burden of the Games and ensure that our Olympic venues have reliable power. We have tested the system in weather conditions ranging from lightning storms to the extreme heat and humidity of southern summers. CellNet has a highly reliable system which has performed in these conditions and answers our specific needs as a utility. We look forward to working with CellNet during the Olympic Games, one of the most challenging events that an electric utility can face."

CellNet presently has two Cell Masters installed in the Atlanta area, each capable of handling communications with more than 50,000 customers. The system will also control 65 Remote Terminal Units, including 30 automated switches and 15 capacitor bank controllers, which are already installed and operational. This equipment will provide Georgia Power with circuit voltage/VAR information and automated control capabilities. If Georgia Power were to fully deploy CellNet's automation technology, it could eventually cover 1.7 million customers in Georgia Power's system, with potential benefits to the utility's capacity utilization, demand management, and crisis response.

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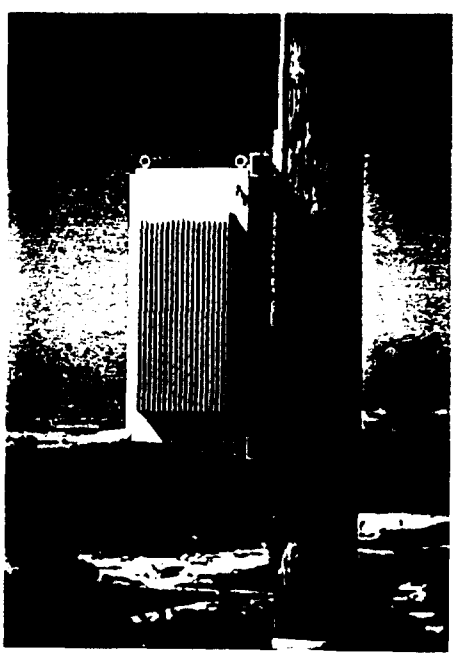
VOICE OF THE ELECTRIC UTILITY INDUSTRY

PG&E expands radio system

SAN FRANCISCO—Pacific Gas & Electric Co. was the first U.S. utility to install a digital cellular radio network to automate a portion of its distribution system.

PG&E installed its CellNet system of communication, which is a product of CellNet Data Systems, San Carlos, Calif., beginning in 1990 to support distribution feeder automation, demand-side management, and residential, commercial and industrial metering.

A pilot program verified the performance of the digial cellular radio system and networking protocols. The hilly terrain in San Rafael (north of San Francisco) was the proving ground for the system.



PG&E's North Bay Division operates a two-way, digital, cellular radio network within the FCC licensed 952/928 MHz MAS frequency band. Cell Masters are installed to manage communications within each cell of the network.

Beginning in 1991, distribution automation applications were incorporated into the system. Its main goal was to increase available capacity by improving the utilization of facilities through dynamic loading, which also reduced, or deferred, capital expansion projects.

Other side benefits included improvements in power quality and service reliability.

PG&E uses phone lines for communicating with remote terminal units (RTUs) in large substations. For the cost-sensitive points along the distribution feeders, RTUs with built-in CellNet remote radios are installed (see photo). The system provides standard interfaces and supports a number of system control and data aquisition (SCADA) protocols, so RTUs from a variety of vendors can be supported on the network.

PG&E uses RTUs and controllers from Energyline, Landis & Gyr, Harris, and Cooper to monitor and control distribution equipment. Analog input values, such as voltage and current data, and digital inputs, such as equipment status, are brought back over the radio network from dozens of line reclosers, line monitors, capacitor bank controllers and switch controllers.

After several months of functional and stability testing last year, PG&E confirmed that the system met performance criterion, and the R&D group could transfer control of the project to distribution operators.

The UNIX-based CellNet system controller at the North Bay Division office in San Rafael communicates over dedicated facilities to a SCADA Master at the Distribution Office.

The fast response time of the radio system enables a true select-before-operate command sequence that is completed in seconds. The system is designed to allow PC users with system password privileges to access CellNet applications remotely.

The system will eventually support automatic meter reading and demand-side-management applications.

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Fortnightly

"TOU" Rates Hold Out $13- billion Prize

BY CHRIS SLABOSZEWICZ

By 2000, U.S. electric utilities will add 90,000 MW of generating capacity to meet peaking needs. Rather than spend $45 billion on these power plants, which will be used only a couple of hundred hours each year, electric utilities could use incentive pricing-residential time-of-use (TOU) rates-to save consumers up to $13 billion. The combination of market forces and new technology to support automatic meter reading and other applications makes these savings not only possible but practical.

Unlike prices at other capacity-constrained industries such as airlines or telephone companies, electric utility prices usually do not vary by time of day. The result is average capacity factors of 43.8 percent (based on 1989 data), compared to a U.S. airlines average of 63.2 percent. Significantly, the airline average used to be below 50 percent in 1970, when they, like electric utilities, were closely regulated. Through incentive pricing, airlines were able to achieve almost a 30-percent increase in efficiency. According to studies by the Electric Power Research Institute (EPRI) and Edison Electric Institute (EEI), TOU pricing could increase the efficiency of U.S. power plant use by nearly 15 percent.

Power plant needs for the next seven years offer an excellent opportunity to use TOU pricing to save consumers billions of dollars. According to Burns & McDonnell, an engineering firm, new electric generation resources will not be needed before the turn of the century to prevent a projected deficit of peaking capacity. Indeed, Burns & McDonnell estimates a current excess of 152,000 MW in nationwide baseload capacity. TOU pricing, according to EPRI and EEI, causes residential consumers to reduce their onpeak electricity consumption by 20 percent. With a residential peak load of 183,000 MW, this reduction translates into over 36,000 MW of capacity. In other words, residential TOU rates have the potential to provide 40 percent of the peaking capacity needed by the end of the decade. The savings are passed on to consumers, and there are no environmental effects. The result, like that of Adam Smith's invisible hand, is betterment for all the parties involved.

Based on the Census Bureau's 1993 estimate of 101 million residential electric customers and the EPRI and EEI use estimates, residential TOU pricing would cause a reduction of 36,400 MW of peak demand. With the average installed cost of peaking units at about $500 a kilowatt, the gross savings would be $18 billion. (Of course, the incremental

cost of TOU metering must be subtracted from this amount.)

Many automatic meter-reading technologies include the ability to offer TOU rates. Providers of such systems include Metricom, American Innovations, General Electric, and my firm, CellNet Data Systems Inc. These systems can be installed for $100 to $200 a home. The benefits from eliminating meter reading range from $20 to over $100 a home, but typically average $50. Using the $100 total-cost figure, the incremental cost of providing TOU metering would be about $50 a home when installed as part of an automatic meter-reading solution.

Subtracting $50 a home, or a total of $5 billion, from the $18 billion yields net savings of $13 billion—over $100 a consumer.

TOU pricing was the subject of much discussion during the energy crisis in the 1970s. Then, as now, proponents favored TOU rates for their ability to improve the use of power-generation resources. The result was dozens of studies of these rates for residential as well as commercial and industrial (C/I) customers.

EPRI consolidated these studies' findings in a 1990 report, *Predicting and Measuring Response to Innovative Pricing Options*. The studies found that TOU pricing did, in fact, cause electric customers to alter their consumption patterns. This finding was consistent across studies, although load impacts varied depending on the relationship between peak and offpeak prices as well as the length and timing of the peak period.

Two important results emerge from reviewing the plethora of data from these TOU rate studies. First, residential customers have far higher price elasticities for electricity than C/I customers. In other words, residential customers are far more responsive to price differences between peak and offpeak times. The 20-percent reduction in onpeak residential electricity consumption cited by EPRI and EEI compares to only a 3-percent reduction for commercial customers. This finding is in sharp contrast to actual implementation of TOU rates, which usually begins with large industrial customers, but is in line with common sense: A homeowner can easily wait for offpeak hours to do the laundry, while a shopkeeper cannot afford to turn off the lights while customers are in the store.

The second key finding, reported by Arizona Public Service Co. (APS) (which serves the hottest portion of the country), is that TOU load impacts on system peak days are the same as on other days. This contrasts with the belief that consumer response stops when temperatures top 100 degrees. Common sense agrees with APS's research results: Customers who have changed habits to avoid onpeak consumption every day do not change their habits again simply because the temperature is higher. The same is true of airline passengers who take red-eye flights or book tickets weeks or months ahead, even though they are flying during peak holiday periods.

What has changed recently about residential TOU pricing is technology. Central switching was the technology that made TOU pricing possible for telephone use. Automatic meter reading will make widespread TOU pricing possible for electricity.

The first reason is capital costs. With automatic meter-reading systems, the cost of the system is shared by the meter-reading function. The result is a much lower burden for the incremental cost of TOU metering. Some utilities are installing automatic meter-reading equipment based on savings alone; in these cases, TOU capability is almost free (although there are still costs associated with billing system modifications and program administration).

The second reason is maintenance. When I managed Pacific Gas & Electric's residential TOU program in the mid-1980s, TOU meters had the potential to be maintenance nightmares. With an automatic meter-reading system, reprogramming can be done remotely and automatically at virtually no cost once the system is in place. And because any meter problems are reported within minutes by the system, TOU meters are not sitting idle for up to a month waiting for a human meter reader to note a problem. The result of these maintenance features is a further reduction in the cost of implementing TOU rates.

We depend on the free market to run our economy efficiently. Residential TOU rates can help electric consumers avoid $18 billion in power plant investment, increase the efficiency of the electric utility industry, and minimize environmental effects. The rates have proved effective in dozens of studies by utilities throughout the United States. Automatic meter-reading technology now makes these rates economical and practical. ▼

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